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ANOPSILANA CRENATA, A NEW TROGLOBITIC CIROLANID ISOPOD FROM GRAND CAYMAN ISLAND, CARIBBEAN SEA

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Abstract.—*Anopsilana crenata,* a new blind unpigmented cirolanid isopod, is described from a freshwater pool in West Bay Cave, a small cave at the NW end of Grand Cayman Island. The cave is formed within limestone of the Late Pleistocene Ironshore Formation, whose age is probably about 130,000 years BP. The possibility that the 5 species of *Anopsilana* evolved by convergence rather than from a common ancestor is discussed.

The genus *Anopsilana* (Cirolanidae) was established by Paulian and Delamare Deboutteville (1956) for a new blind unpigmented isopod from fresh water in Mitoho, a cave in southern Madagascar. This species, *A. poissoni,* is still known only from the type-locality. Vandel (1964) expressed doubts about the validity of *Anopsilana,* and Monod (1976) illustrated *A. poissoni* in detail from 2 specimens given to him by Delamare Deboutteville and placed it in *Cirolana.* Monod analyzed point by point the statements in the original diagnosis of *Anopsilana* and found nothing that excluded *A. poissoni* from *Cirolana.*

When Bruce (1981) distributed species of the cumbersome genus *Cirolana* among 6 genera (including 3 new genera), he recognized *Anopsilana* as valid because it differed from *Cirolana* in having non-setigerous endopods on pleopods 3–5 (in *Cirolana* the endopods of pleopods 3 and 4 are setigerous). Monod (1976) did not include the pleopods in his analysis, presumably because they were not mentioned in Paulian and Delamare Deboutteville's original diagnosis of *Anopsilana.* Bruce (1981) included in *Anopsilana* the type-species, *A. poissoni,* and 3 species that he removed from *Cirolana*: *A. luciae* (Barnard 1940), *A. pustulosa* (Hale 1925), and *A. willeyi* (Stebbing 1904). The new species described below brings the number of known species to 5.

Anopsilana crenata, new species
Figs. 1–2

Material.—Grand Cayman I., Cayman Is. (Caribbean Sea, NW of Jamaica), West Bay Cave (known locally as "Blue Hole"), a sink located on a limestone rise at NW end of island (Fig. 3) 200–300 yds (180–275 m) from the sea at an elevation of 20 ft (6.1 m) above sea level, 0.5 km NNE of green turtle farm (Mariculture, Ltd.); leg. M. Langworthy and G. Morgan, 18 April 1980: ♂ holotype (USNM 190712) and 37 ♂♀ paratypes (USNM 190713).

Etymology.—The specific name, from the Latin "crenatus" (notched), refers to the scalloped appearance of the palm of the propus of pereopod 1.

Description.—Blind, unpigmented. Length of largest specimen 6.2 mm. Body slightly more than 2× as long as wide, greatest width at pereonite 5. Head with weak lateral angles, anterior margin produced into small rostrum reflexed ven-

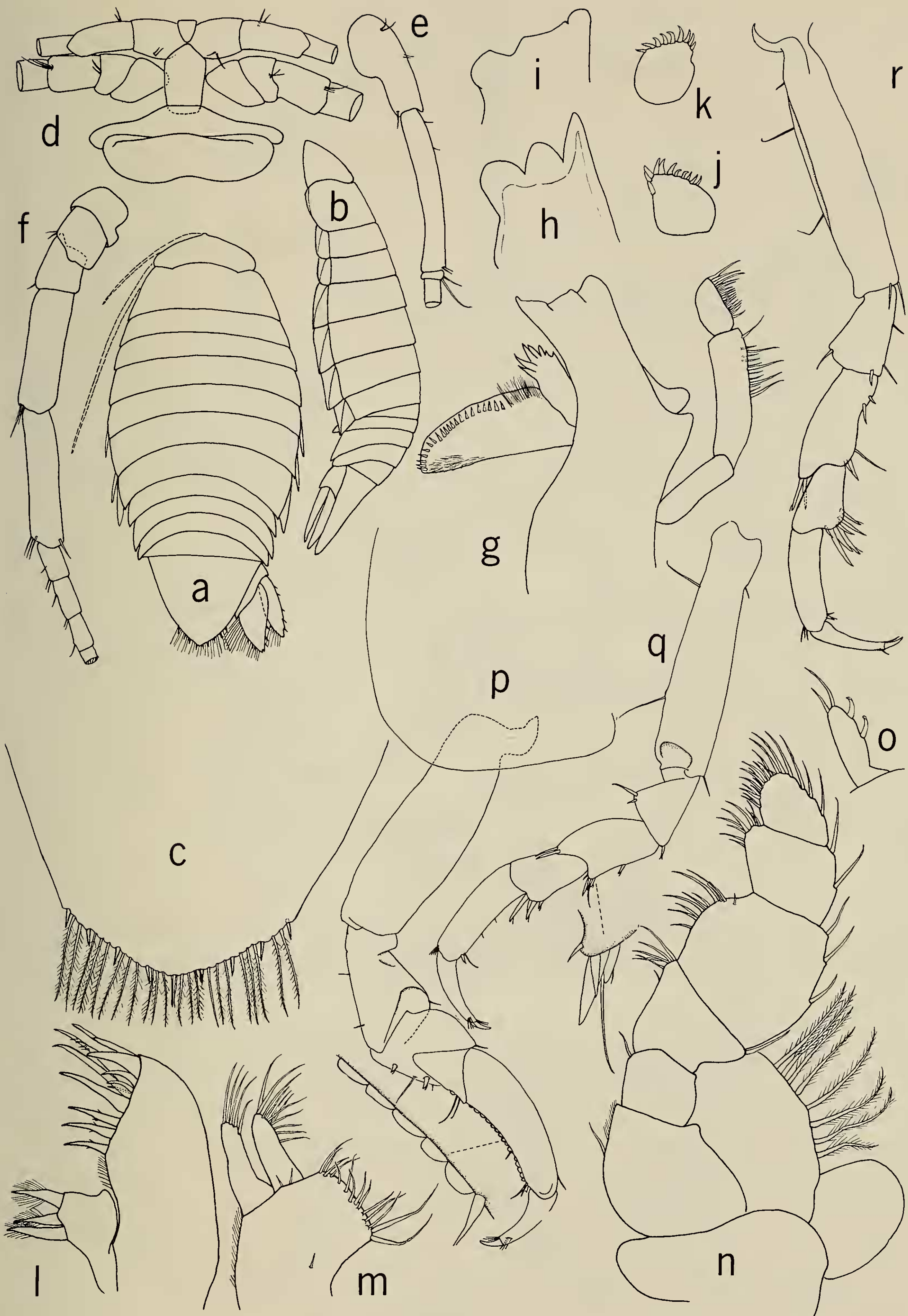

Fig. 1. *Anopsilana crenata*: a, Habitus, dorsal; b, Habitus, lateral; c, Apex of telson; d, Anterior region of head, ventral; e, Antenna 1 peduncle; f, Antenna 2 peduncle; g, Left mandible; h, i, Incisors of right and left mandibles; j, k, Laciniae of left and right mandibles; l, Maxilla 1; m, Maxilla 2; n, Maxilliped; o, Endite of maxilliped; p, Pereopod 1; q, Pereopod 2; r, Pereopod 3.

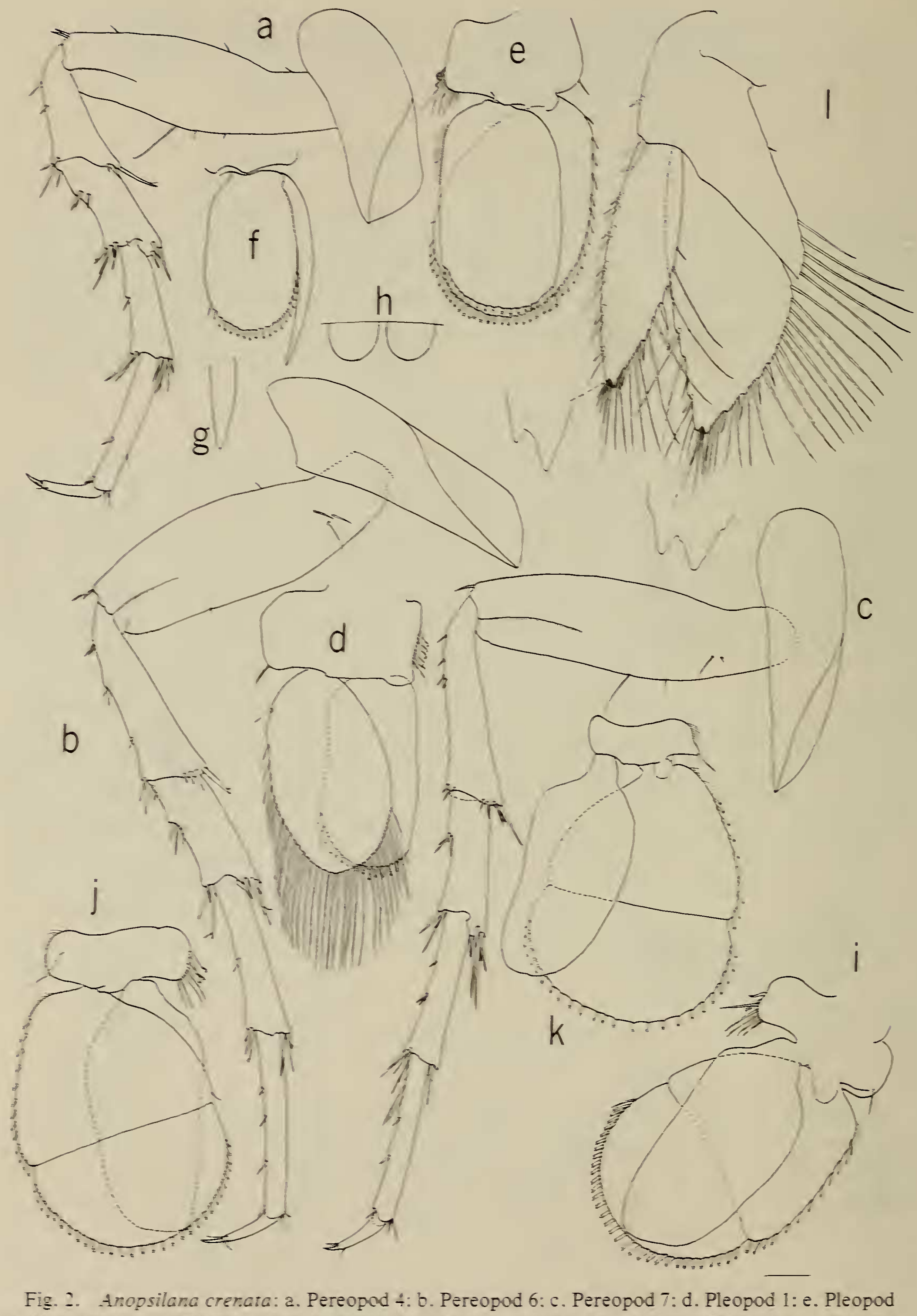

Fig. 2. *Anopsilana crenata*: a. Pereopod 4; b. Pereopod 6; c. Pereopod 7; d. Pleopod 1; e. Pleopod 2, ♀; f. Endopod of ♂ pleopod 2; g. Apex of appendix masculina; h. Penes; i. Pleopod 3; j. Pleopod 4; k. Pleopod 5; l. Uropod, ventral.

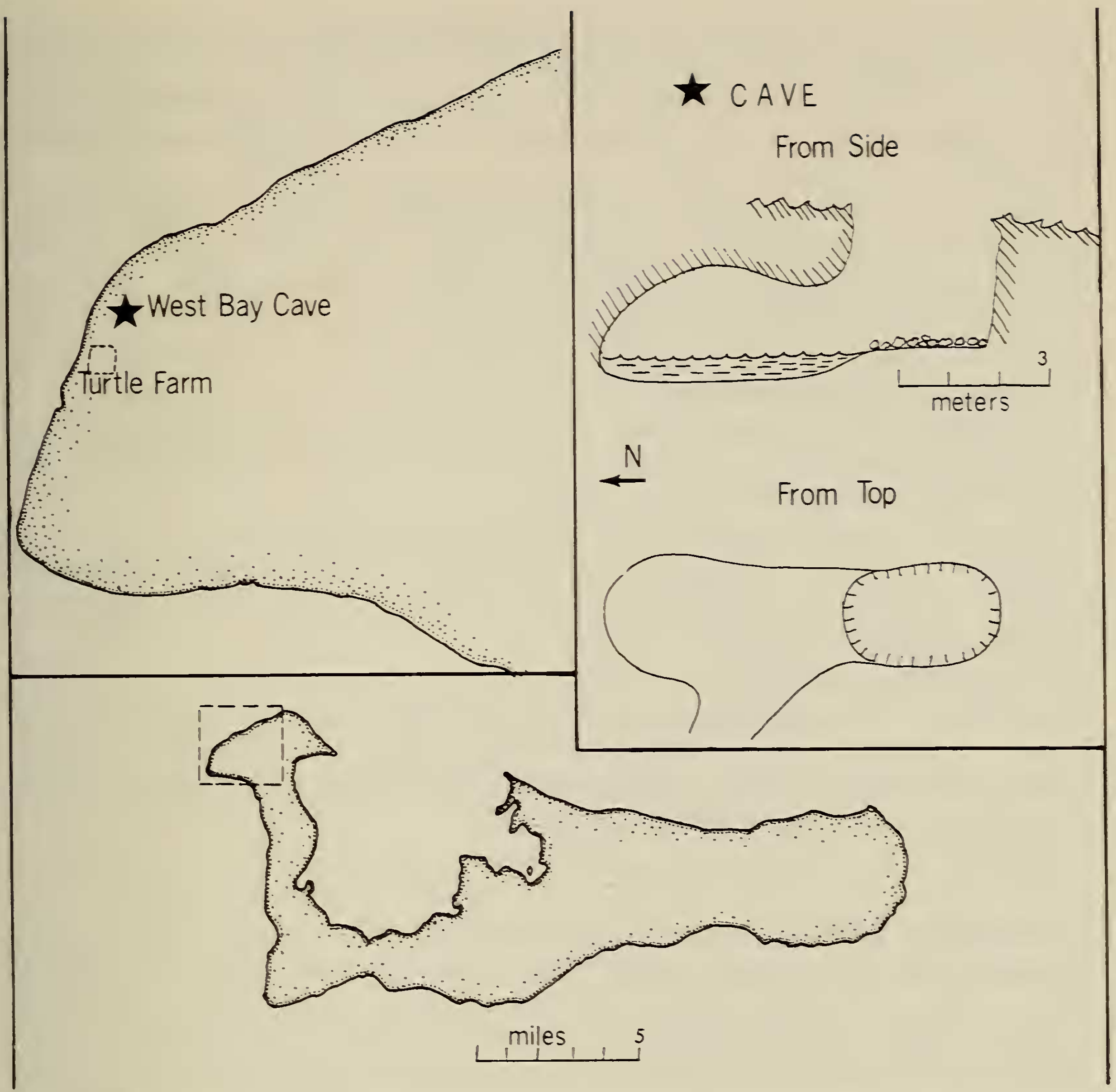

Fig. 3. Below, Outline map of Grand Cayman Island; Upper left, NW end of Grand Cayman Island, showing location of West Bay Cave; Upper right, West Bay Cave in profile and from above, from field sketches.

trally between bases of antennae 1 and meeting frontal lamina. Frontal lamina pentagonal, about 1.6× longer than wide, not produced ventrally, posterior margin overlapped by clypeus. Clypeus short, about 0.66× length of labrum.

Pereonite 1 the longest; pereonites 2–5 gradually increasing in length, pereonite 6 subequal to or slightly shorter than pereonite 5, pereonite 7 distinctly shorter. Posterior corners of coxae 2–3 rounded, of coxae 4–6 squared, of coxa 7 angular, overlapping pleonites 1–2; all coxae with oblique carinae.

Pleonites subequal in length; pleonite 1 at least partly overlapped by pereonite 7; pleonite 5 overlapped laterally by pleonite 4; epimera of pleonites 2–3 pointed, of pleonite 4 rounded. Telson triangular, about 0.75× as long as wide, posterior margin rounded, encompassing about 0.2 telson, armed with 8 short slender spines; between 2 lateral spines are 2 plumose setae, between other spines are 3 plumose setae.

Antenna 1 nearly reaching posterior margin of pereonite 1; peduncle segments 1–2 fused dorsally, free ventrally; flagellum of 8–10 segments, last 5 segments with 2-2-2-1-0 esthetes (counting distally). Antenna 2 reaching midlength to posterior margin of pereonite 5; peduncle segment 5 only slightly longer than segment 4; flagellum with 18–22 segments.

Incisors of mandible 3-cuspate, cusps more deeply separated in right mandible; right and left laciniae with 9 and 11 spines; molar with 18 and 21 spines on right and left mandible, respectively. Exopod of maxilla 1 with 12 spines (1 not shown in Fig. 1l); endopod with 3 circumplumose spines. Maxilla 2 with 5 and 11 setae on palp and exopod, respectively; endopod with 16 setae of varying lengths (only 14 shown in Fig. 1l). Maxilliped with 2 retinacula.

Pereopod 1, palm of propus armed with low rounded scales giving it a scalloped appearance. Pereopods 2–7 slender, successively longer, ischium, merus, and carpus with distal groups of strong spines.

Penes low, rounded, slightly wider than long, close together.

Pleopod 1 endopod with slightly concave lateral margin. Pleopod 2 endopod, appendix masculina bow-shaped, tapering to narrowly rounded apex, extending beyond endopod by nearly 0.2 its length.

Uropods reaching slightly beyond apex of telson; exopod slightly shorter and about 0.6 as wide as endopod, lateral margin with 5 spines, medial margin with 3 spines; apical notch asymmetrical with longer medial side. Endopod triangular, lateral margin with 2 spines, medial margin with 4 spines; apical notch nearly symmetrical, with slightly longer medial side.

Comparisons.—Of the known species of *Anopsilana, A. luciae, A. pustulosa,* and *A. willeyi* differ from *A. crenata* in having well developed eyes and in living in estuarine or marine habitats. *Anopsilana luciae* differs further in the rounded rather than angular anterior margin of the frontal process, which is visible in dorsal view, and in the absence of marginal spines on the telson. *Anopsilana pustulosa* differs in the presence of tubercles on the pleonites and posterior pereonites, the 2 carinae on the telson, and the more pointed telson. *Anopsilana willeyi* also has a tuberculate body and a pointed telson with concave lateral margins.

Anopsilana poissoni, like *A. crenata,* is a blind, unpigmented freshwater troglobite, but has many points of difference, including a longer and narrower frontal lamina, a pereopod 1 palm with 2 spines and no rounded scales, a much longer appendix masculina with an abrupt bend, uropods much longer than the telson, exopod longer than the endopod and much narrower than in *A. crenata.*

Habitat

Based on the geological map presented in Brunt *et al.* (1973), West Bay Cave is developed in the limestone of the Ironshore Formation. This limestone, composed of poorly consolidated reef limestone, calcarenites, and lagoonal muds and sands, lies unconformably on the much older and more massive Bluff Limestone Formation (Brunt *et al.* 1973). The Ironshore Formation, which occurs at elevations of less than 5 meters above sea level, probably represents a Late Pleistocene reef terrace. Other reef terraces from similar elevations in South Florida, the Bahamas, and Jamaica have been dated at approximately 130,000 years BP

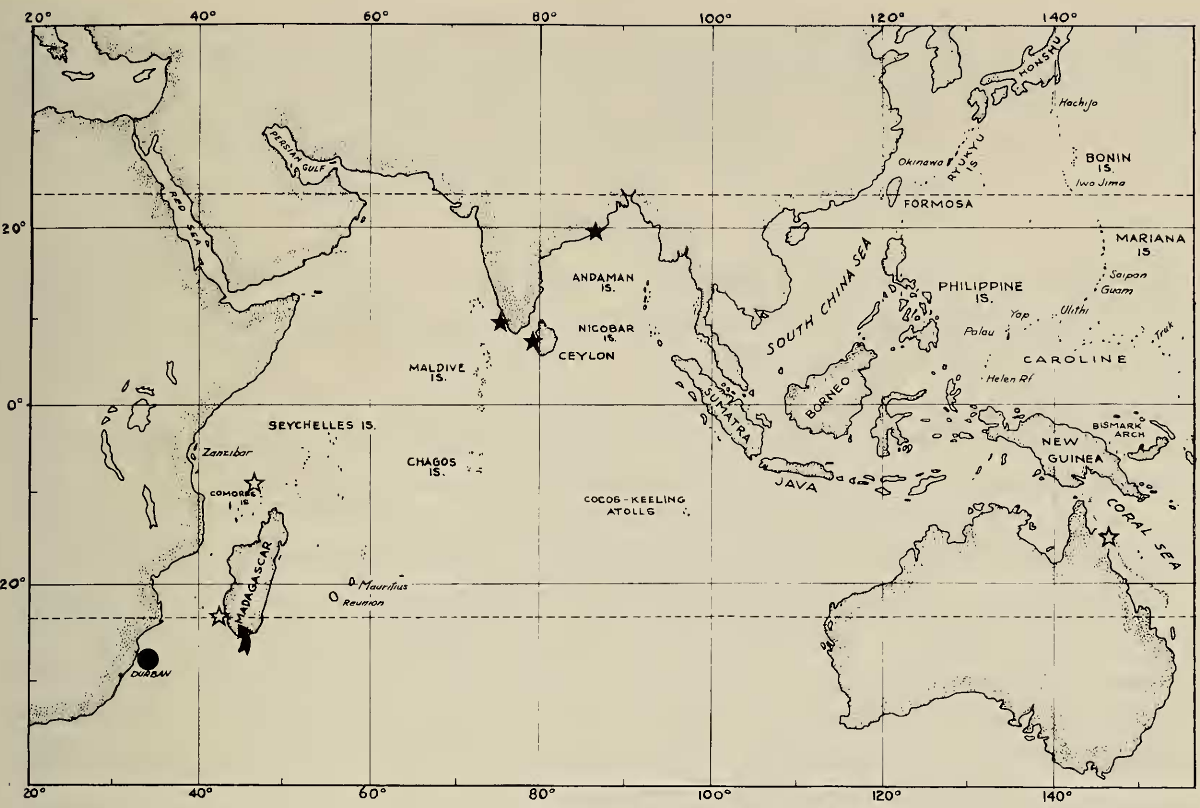

Fig. 4. Known distribution of species of *Anopsilana*, except *A. crenata*: Solid stars, *A. willeyi*; Open stars, *A. pustulosa*; Solid circle, *A. luciae*; Arrow, *A. poissoni*.

using Th^{230}/U^{234} ratios in unaltered fossil corals (Broecker and Thurber 1965, Cant 1972, Neumann and Moore 1975, Osmond *et al.* 1965). Presumably, the Ironshore Formation is of similar age (Brunt *et al.* 1973, Morgan 1977).

The cave is located on the north flank of a low limestone ridge that rises gradually from the present western shoreline. Access to the cave is through a vertical sinkhole, approximately 2.5 meters deep. The cave itself consists of a single chamber, about 8 meters in length, and 0.5–2.0 meters in height. The entire chamber receives light from the entrance. The cave pool, which begins just inside the entrance, covers the entire cave floor with up to 20 cm of fresh water. The water is crystal clear and fresh to the taste. Presumably, as on other small, low-lying Caribbean islands, the cave pool represents a locally-derived freshwater lens atop a large volume of salt water. The floor of the cave, as well as the adjacent sinkhole, consists of broken chunks of the white limestone; fine organic silt is present in small areas adjacent to the entrance and the sinkhole. The silt apparently is derived from surface soils and detritus funnelled through the sinkhole into the cave. The sinkhole is shaded by gumbo-limbo (*Bursera simaruba*) and West Indian almond (*Terminalia catappa*).

Cirolanid isopods were extremely abundant in the cave pool, as evidenced by the large numbers of individuals represented in the sample. Swimming isopods filled the water column, and were rarely observed at rest on the bottom or on the vertical surfaces of the broken limestone. No other aquatic organisms were observed in the cave pool. No bats, or signs of bats, were seen in the cave. Surface animals such as amblypygids, scorpions, gastropods, and small geckoes (*Sphaerodactylus argivus*) were observed on the vertical walls and bottom of the sink and on the slope adjacent to the water. Several adult treefrogs (*Osteopilus septentrionalis*) were found in small solution pits in the wall of the sink.

Zoogeography

Except for *A. crenata* the species of *Anopsilana* are distributed in the Indo-Pacific (Fig. 4). *Anopsilana willeyi* is known from Lake Negombo, Ceylon (Stebbing 1904, Barnard 1935), Chilka Lake, India (Barnard 1935), and the coast of Kerala state, India (Pillai 1954, 1961, 1967). *Anopsilana pustulosa* has been reported from Cooktown, Queensland, Australia (Hale 1925), Tulear, Madagascar (Roman 1970), and Aldabra atoll (Jones 1976). *Anopsilana luciae* is known only from St. Lucia Bay, Zululand, South Africa (Barnard 1940). The type- and only locality for *A. poissoni,* a cave in Madagascar, has already been mentioned.

Assigning these Indo-Pacific species to a common genus does not create problems in zoogeography, but the discovery of a congeneric freshwater troglobitic species on a Caribbean island cannot be easily explained. Assigning the Cayman Island species to *Anopsilana* implies that it shares common ancestry with the Indo-Pacific species. The discovery of additional Atlantic species of *Anopsilana* would be helpful, but cannot be anticipated.

A possible alternative explanation to common ancestry is convergence. The only character separating *Anopsilana* from *Cirolana* is the absence of setae from the endopods of pleopods 3–5. Bruce (1981) has pointed out that the species of *Anopsilana* are from either brackish or freshwater habitats, and that reduction of marginal setae is associated with movement into fresh water. Almost all freshwater Cirolanidae are troglobitic, and all 14 genera of troglobitic cirolanids lack marginal setae on pleopods 3–5. Very few marine cirolanids have pleopods with this attribute.

Thus it seems possible that at least some of the species of *Anopsilana,* and especially *A. crenata,* have independently lost the setae of pleopods 3–5. If this happened, the species involved do not have common ancestry and are not congeneric. The convergence explanation is appealing for *A. crenata,* which can then be derived from a local marine species of *Cirolana,* and its relation to the Indo-Pacific species of *Anopsilana* need not be dealt with.

If it can be demonstrated convincingly that loss of the setae of pleopods 3–5 has evolved independently in the species of *Anopsilana* in response to decreased salinity of their habitats, this genus will have to be abandoned and its species returned to *Cirolana.* For the time being it is convenient to retain *Anopsilana.*

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Literature Cited

Barnard, K. H. 1935. Report on the Amphipoda, Isopoda and Tanaidacea in the collections of the Indian Museum.—Records of the Indian Museum 37:279–319.

———. 1940. Contributions to the crustacean fauna of South Africa. 12. Further additions to the

Tanaidacea, Isopoda, and Amphipoda, together with keys for the identification of hitherto recorded marine and freshwater species.—Annals of the South African Museum 32:381–515.

Broecker, W. S., and D. L. Thurber. 1965. Uranium-series dating of corals and oolites from Bahaman and Florida Keys limestones.—Science 149:58–60.

Bruce, N. L. 1981. Cirolanidae (Crustacea: Isopoda) of Australia: Diagnoses of *Cirolana* Leach, *Metacirolana* Nierstrasz, *Necirolana* Hale, *Anopsilana* Paulian & Debouteville, and three new genera—*Natolana, Politolana* and *Cartetolana*.—Australian Journal of Marine and Freshwater Research 32:945–966.

Brunt, M. A., M. E. C. Gigliolo, J. D. Mather, D. J. W. Piper, and H. G. Richards. 1973. The Pleistocene rocks of the Cayman Islands.—Geological Magazine 110(3):209–304.

Cant, R. V. 1972. Jamaica's Pleistocene reef terraces.—Journal of the Geological Society of Jamaica 12:13–17.

Hale, H. M. 1925. Review of Australian isopods of the cymothoid group. Part I.—Transactions of the Royal Society of South Australia 49:128–185.

Jones, D. A. 1976. The systematics and ecology of some isopods of the genus *Cirolana* (Cirolanidae) from the Indian Ocean region.—Journal of Zoology, London 178:209–222.

Monod, T. 1976. Remarques sur quelques Cirolanidés (Crustacés, Isopodes).—Bulletin du Muséum National d'Histoire Naturelle (3) 358, Zoologie 251:133–161.

Morgan, G. S. 1977. Late Pleistocene fossil vertebrates from the Cayman Islands.—Master's Thesis, University of Florida, Gainesville. 283 pp.

Neumann, C. A., and W. S. Moore. 1975. Sea level events and Pleistocene coral ages in the northern Bahamas.—Quaternary Research 5:215–224.

Osmond, J. K., J. R. Carpenter, and H. L. Windom. 1965. Th^{230}/U^{234} age of the Pleistocene oolites and corals of Florida.—Journal of Geophysical Research 70(8):1843–1847.

Paulian, R., and C. Delamare Deboutteville. 1956. Un Cirolanide cavernicole à Madagascar (Isopode).—Mémoires de l'Institut Scientifique de Madagascar série A, 11:85–88.

Pillai, N. K. 1954. A preliminary note on the Tanaidacea and Isopoda of Travancore.—Bulletin of the Central Research Institute University of Travancore, Trivandrum 3(1):1–21.

———. 1961. Monograph wood-boring Crustacea of India.—Government of India Press, Simla, x + 61 pp.

———. 1967. Littoral and parasitic isopods from Kerala: families Eurydicidae, Corallanidae and Aegidae—2.—Journal of the Bombay Natural History Society 64(2):267–283.

Roman, M.-L. 1970. Écologie et répartition de certains groupes d'Isopodes dans les divers biotopes de la région de Tulear (sud-ouest de Madagascar).—Recueil des Travaux de la Station Marine d'Endoume, Faculté des Sciences de Marseille, Fascicule Hors Série, Supplement no. 10:163–208.

Stebbing, T. R. R. 1904. Marine crustaceans. XII. Isopoda, with description of a new genus.—Fauna and Geography of the Maldive and Laccadive Archipelagoes (J. Stanley Gardiner, ed.) 2(3):699–721, pls. 49–53.

Vandel, A. 1964. Biospéologie: la biologie des animales cavernicoles.—Gauthier-Villars, Paris, xviii + 619 pp., 11 pls.

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